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The Construction of a Firm's Governance Structure in a Setting of Uncertainty

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Why does the firm look the way it does? Why does it have the structures it has? In particular, what is the function of the board of directors? Many papers have tried, and failed, to link the board's structure to the performance of the firm. Might the board have an alternative rationale for existence? In this paper, I explore the possibility of the board being used as a signaling device. The management, having information about the state of the world the investor does not, constructs a signal (the board of directors) to promote efficiency in an uncertain world. The construction of the board signals the state of the world to the investor, reducing the uncertainty, and thereby attracting necessary capital to the firm. I then examine the size of the signal with respect to other key firm characteristics. I find that the size of the signal diminishes as investors become more concentrated.

INTRODUCTION

Why do firms look the way they do? What incentives give rise to the structure of the firm? There are many types of organizations in the marketplace, amongst which resides the publicly traded firm.

In particular, the role of the board of directors of the publicly traded firm remains difficult to pinpoint. Many authors have tried to examine various aspects of the board to determine what types of boards lead to better firm performances. However, as yet, no such links have been found. This brings into question the board's purpose. Do firms use it to enhance performance as typically thought? Does it have alternative uses? Is it simply a product of government intervention (publicly traded firms are required by law to have a board of directors)? At the very least, there might be several motives for having a board of directors.

In this paper, I examine an alternative rationale for the structure of the board of directors in a publicly traded firm, proposing a theory to model it. Instead of the widely accepted (although to date empirically unsubstantiated) rationale where the board serves as a performance enhancer (supplying oversight to the firm), I argue that the board might be used as a signaling device. In order to alleviate concerns that investors might have with respect to the well-being of the firm, the managers construct a board of directors to transmit this information.

I construct a game of incomplete information where the manager has the ability to write the contract and only he sees the true state of the world before implementing the contract.

The game's structure has two players—an investor and a manager.[1] Since the manager gets to choose (in large part) the board of directors, he can choose either an independent board (comprised of outsiders), an insider board, or some mix of insiders and outsiders. The choice of the board signals the state of the world to the investor—since an independent board imposes costs on the manager, the more independent the board, the better the state of the world.

Therefore, upon seeing the true state of the world, the manager writes a contract (for his proposed wage) and constructs a certain board

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composition. Upon seeing the board composition, the investor updates her belief about the state of the world and decides whether or not to accept the contract, sending her capital to the firm contingent upon acceptance of the contract. The manager then uses the capital for productive purposes, and payoffs accrue.

Since the board of directors only serves to signal the state of the world, the first best solution would be one where the firm's board of directors would only consist of insiders—those that do not impose a cost to the firm or the managers. However, given the nature of the asymmetric information, the first best solution cannot be achieved and we would expect to see outsiders on the board of directors.

The following section contains a brief literature review. The next section holds the model. The subsequent section contains results on existence of separating and pooling equilibria. The penultimate section has comparative static results while the final section concludes the paper.

THEORETICAL BACKGROUND

The standard principal/agent model with hidden actions has an owner selecting a contract that aligns incentives for the manager with those of the owner, producing efficiency within the firm.[2] Extensions of the principal/agent problem to a multi-tiered hierarchical structure have also been studied[3] where collusion becomes a potential problem between the supervisor hired to monitor the agent and the agent. Similar to the previous literature, however, contractual relations enacted by the owners determine the incentive structure and help attain an efficient outcome.

Myers and Majluf (1984) and Narayanan (1988) explore how, in a setting of asymmetric information where managers have information that investors or owners do not have, managers use the debt/equity ratio of the firm to signal the state of the world to the owners/investors. In this way, outsiders can properly evaluate the value of the project to be undertaken or even the firm itself.

Hart (1995), on the other hand, explores the different ways that owners can keep managers from acting opportunistically through the design of the financial structure of the firm. By issuing debt instead of equity, the owners can help restrain the managers from acting against the interests of the owners. While clearly a part of the governance structure of the firm, this approach does not help explain how the financial structure is determined, other than assuming that the capital structure reflects the preferences of the owners but not the management. Why are the owners' preferences upheld in a situation where they have little recourse?

Comparing Myers and Majluf's and Narayanan's results with Hart's, however, makes it difficult to truly understand which of the motives is being used, since the two arguments have observationally equivalent outcomes. If the managers wish to reveal that the firm's value is underpriced or that a new project is undervalued, they will issue debt rather than equity. However, Hart argues that the debt might be issued if the owners wish to constrain the actions of the managers. Finally, if the managers have control over the debt/equity ratio of the firm, they might even be using debt *to constrain their own actions*, an avenue not fully explored in the above-cited literature (this issue might boil down to who has the ability to manipulate the debt/equity ratio and why). Which of these rationales caused the firm's financial structure to come about?

While important to understand the financial structure of the firm, these arguments do not explain the structure of the board of directors. Given the noise in the potential signal (of issuing debt versus equity) it might behoove the management to use a different type of signal to assure outsiders (investors) of the profitability of the firm. They might do so by manipulating the structure of the board of directors.

Throughout much of this literature, the owner provides the incentives for the manager to supply effort. However, especially in larger firms with dispersed ownership, the separation of ownership and management implies the impossibility of this arrangement. Since the owners cannot write contracts, it falls on the shoulders of the management to provide incentives for the owners (and investors) to supply capital. The managers can accomplish this by writing the contracts that the owners cannot.[4]

Shivdasani and Yermack (1999) argue that the managers of the firm have a large influence over who gets selected to the board of directors. Many times, the CEO or another insider is an integral part of the committee to elect new members to the board. Even when not part of such a committee,

Shivdasani and Yermack argue that insiders have a large influence (most times through the CEO). Independent board members will rely upon the CEO's (or insider's) advice and suggestions concerning the election of new board members.

I explore the possibility that the management selects the board of directors of the firm and how it might do so. The management, taking into account the ability (or lack thereof) of the investors[5] to monitor/write contracts/be involved in the decision-making processes of the firm, creates a board structure to attract capital to the firm in a setting of uncertainty.

THE MODEL

The game works as follows: At the beginning of the game, Nature moves, selecting a state of the world (θ). The manager views the move of Nature while the investor can only verify the true state of the world at the end of the game. The manager then writes a contract specifying a proposed wage, w, and the number of outsiders to serve on the board of directors, p. The investor, upon seeing p, updates her beliefs about the state of the world and chooses whether or not to accept the contract and sends her capital to the firm (upon acceptance). Then the manager uses the capital for productive purposes, realizes a profit/loss, and payoffs accrue.

The setup is as follows: Let K denote the capital available to the firm while θ represents the state of the world. Call the value function $V(\cdot)$ with arguments capital (K) and the state of the world (θ), written as $V(K;\theta)$. For simplicity, let there exist a high state that occurs with probability λ and a low state that occurs with probability $(1-\lambda)$: $\theta \in \{\theta_H, \theta_L\}$. The manager must ensure that the investor participates (the investor supplies capital) so he must ensure that the expected return to the investor must equal at least what she could get elsewhere in the market. Let $\bar{r}$ denote the return to capital that the investor could get elsewhere. The manager sends a signal to the investor concerning the state of the world, $p \in [0, 1]$, denoting the composition of the board of directors (i.e. the percentage of outsiders on the board of directors).

The game tree below shows the sequence of moves in the game (Figure 1):

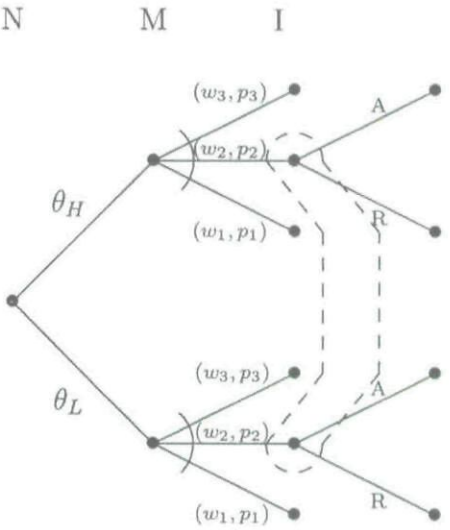

Figure 1. Sequence of moves.

To simplify the game, I assume that the optimal level of capital remains the same for either state of the world. We can think of θ as the productivity of the manager (there might exist two types of managers—a high and a low productive manager revealed to the manager when Nature moves) so that the different states of the world do not require different levels of K. For instance, denoting π as the profit of the firm, we can have $V(K;\theta) = \theta\pi(K)$, where the state of the world enters multiplicatively.

We can then denote the strategy of the manager as choosing a pair of functions $s = (w(\theta), p(\theta))$. For simplicity, let $(w_i, p_i) = (w(\theta_i), p(\theta_i))$ where $i \in \{H, L\}$.

Finally, the manager has a cost to implementing a board with more outsiders on it. This cost is less for the higher state than for the lower state. Denote the cost as $h(p_i, \theta_j)$ where $i, j \in \{L, H\}$.[6] More technically, the cost function has the following properties:

$$\frac{\partial h(p_i, \theta_j)}{\partial p_i} > 0,$$

$$\frac{\partial^2 h(p_i, \theta_j)}{\partial p_i^2} \geqslant 0,$$

$$h(p_i, \theta_L) > h(p_i, \theta_H)$$

and finally

$$\frac{\partial h(p_i, \theta_L)}{\partial p_i} > \frac{\partial h(p_i, \theta_H)}{\partial p_i}$$

for $p_i \neq 0$. If $p_i = 0$ then $h(\cdot) = 0$ and we say that the derivatives at those points also equal zero. These conditions state that the cost of implementing a more outsider dominated board increases (and could increase at an increasing rate) for the manager, but decreases as the state of the world becomes more favorable to the manager. These restrictions imply a single crossing property. Denoting the utility function of the manager as $u_m(\cdot)$ and that of the investor as $u_0(\cdot)$, both assumed to be continuous, the manager then chooses levels of w and p to maximize the following objective function:

$$u_m(w, p; \theta) = w - h(p, \theta). \tag{1}$$

Finally, without loss of generality, let u_0 be the identity, i.e.

$$u_0 = (1 + r)K$$

capturing the utility of the return on her capital. The next section contains the setup for the equilibrium analysis (including the participation constraints for the investor and the incentive compatibility constraints of the manager) and an exploration of the separating equilibria.[7]

EQUILIBRIA

First we want to examine the constraints the manager needs to obey in order to attain an equilibrium. In order to reveal the state of the world truthfully and persuasively (i.e. so that the investor believes his signal), we can restrict the manager's signal to one that must obey the following incentive compatibility constraints:

$$w_H - h(p_H, \theta_H) \geqslant w_L - h(p_L, \theta_H) \tag{2}$$

and

$$w_L - h(p_L, \theta_L) \geqslant w_H - h(p_H, \theta_L). \tag{3}$$

These constraints state that the manager wants to convince the investor that he signals the true state of the world. Therefore, in equilibrium, it forces him to choose a signal and wage that correspond to the true state of the world. Otherwise, the investor might not believe the manager and would not participate.

The manager must also worry about the participation of the investor. The investor must supply capital to the firm in order for the firm to produce output. Upon seeing p, denote the beliefs of the investor that the true state of the world is θ_H as $\mu(p)$ and that the true state of the world is θ_L as $(1 - \mu(p))$. Therefore, the manager faces the investor's participation constraint:

$$\mu(p)[V(K; \theta_H) - w] + (1 - \mu(p))[V(K; \theta_L) - w] \geqslant (1 + \bar{r})K. \tag{4}$$

In other words, the expected return to the investor must be greater or equal to the return she could earn elsewhere in the market.[8]

Separating Equilibrium

The following proposition gives us the wage levels we expect to see in the different states of the world.

Proposition 1:
In a separating equilibrium, the manager contracts for a wage that looks like the following: $w_i = V(K; \theta_i) - (1 + \bar{r})K$, $i \in \{L, H\}$, depending on which state occurs. This in turn leaves the investor with exactly her opportunity cost of capital, no matter the state of the world.

Proof:
Looking at the participation constraint first, we see that

$$\mu(p_H)[V(K; \theta_H) - w] + (1 - \mu(p_H))[V(K; \theta_L) - w] \geqslant (1 + \bar{r})K,$$

which reduces to the following:

$$\mu(p_H)V(K; \theta_H) + (1 - \mu(p_H))V(K; \theta_L) - w \geqslant (1 + \bar{r})K.$$

Suppose that the true state of the world is θ_H. If the beliefs of the investor are correct upon receiving the high signal (which must be the case in equilibrium), then $\mu(p_H) = 1$, reducing the equation to

$$V(K; \theta_H) - w \geqslant (1 + \bar{r})K.$$

Solving for w we find

$$w \leqslant V(K; \theta_H) - (1 + \bar{r})K.$$

Since the manager wishes to maximize his compensation, this means that we will end up with the following:

$$w = V(K; \theta_H) - (1 + \bar{r})K. \tag{5}$$

This in turn implies that the return to the investor (R_0) is $R_0 = (1 + \bar{r})K$, or the opportunity cost of the investor's capital available in the marketplace.

The argument for the wage in the low state of the world is similar. Finally, calling the wage in the high state of the world w_H and that in the low state w_L, we get the result in Proposition 1. □

Since the manager can truthfully reveal the state of the world to the investor, the investor, knowing the state of the world, will only participate if she receives at least her opportunity cost of the capital sent to the firm. On the other hand, the manager, knowing this, maximizes his compensation (the return minus the cost of capital paid to the investor) by giving the investor *just enough* to participate—in other words her opportunity cost. Note that in the separating equilibrium, if the low state of the world happens to incur a loss, the investor would not participate and the firm would not undertake productive activity due to a lack of capital. Therefore, in this setting, the investor cannot incur losses.[9]

If investors see p_H, they will believe that the manager must be operating the firm in the high state of the world. Why? It would be too costly for the manager in the low state of the world to send such a signal and therefore only the manager in the high state of the world could afford to do so. Therefore, the investor must (correctly) assign a probability of one that the manager is operating in the high state of the world when she sees the signal p_H.

Now we need to know what the level of the signals will look like. The following lemma shows that in a separating equilibrium the manager will set $p_L = 0$.

Lemma 1:
In any separating equilibrium, the manager will choose $p_L = 0$. In other words, the manager will send a zero signal in the low state of the world.

Proof:
Suppose not. Suppose that the manager chooses $0 < p_L < p_H$. (Note that p_L necessarily lies below p_H, otherwise it would not be a separating equilibrium.) Since the investor sees a signal that is *not* p_H (and in fact is strictly less than p_H) she knows that it cannot be the high state of the world. Therefore, she assigns probability one to the state being the low state of the world and will only accept a contract where the manager receives w_L (by Proposition 1). The manager could already receive w_L by sending a zero signal, but has instead incurred a positive cost to signal p_L, making him strictly worse off. This contradicts the assumption that $p_L > 0$ is the low-state manager's equilibrium signal, and we must have $p_L = 0$. □

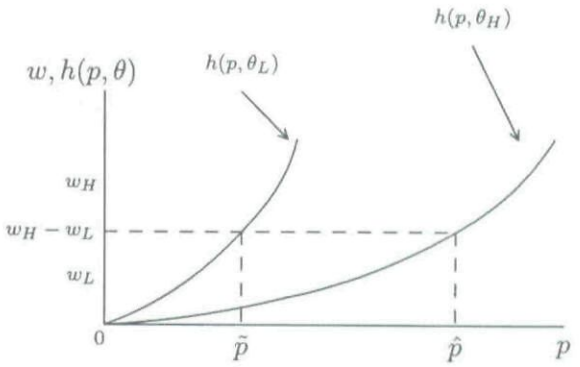

Figure 2. Graphical depiction of the cost function.

Finally, we must determine what p_H looks like in the separating equilibrium. Figure 2 gives the intuition behind what p_H will look like.

The figure shows us the levels of p that support a separating equilibrium. Any $p \in [0, \tilde{p}]$ does not support a separating equilibrium since it allows the manager in the low state of the world to select the same level of p as the manager in the high state of the world. In this case, the manager in the low state of the world can increase his utility by selecting that p, creating a pooling equilibrium.

Any p higher than $\hat{p}$ cannot support a separating equilibrium either. Any such value of p imposes too great a cost on the manager in the high state of the world to implement. The level $w_H - w_L$ corresponds to the manager in the high state's 'reservation wage.' Since he can send a zero signal and receive at least w_L, he does not want to send a signal that is so high that it leaves him with less than w_L. Any signal $p > \hat{p}$ would leave him with less than w_L; he would rather send a zero signal and have the investor think the low state occurred. Thus, only levels of $p_H \in [\tilde{p}, \hat{p}]$ can sustain a separating equilibrium.

The following lemma gives us the range of values that p can take to support a separating equilibrium.

Lemma 2:
The range of board compositions, p_H^*, that the manager can select in order to truthfully signal the high state of the world must satisfy the

following inequality:

$$h(p_H^*, \theta_L) \geq V(K; \theta_H) - V(K; \theta_L) \geq h(p_H^*, \theta_H). \quad (6)$$

The second-best signal would be the level of p_H such that $h(p_H^*, \theta_L) = V(K; \theta_H) - V(K; \theta_L)$.

Proof:
From Equation (3), the incentive compatibility constraint, we have

$$w_L - h(p_L, \theta_L) \geq w_H - h(p_H, \theta_L),$$

which is equivalent to

$$V(K; \theta_L) - (1 + \bar{r})K - 0 \geq V(K; \theta_H) - (1 + \bar{r})K - h(p_H^*, \theta_L),$$

which reduces to

$$V(K; \theta_L) \geq V(K; \theta_H) - h(p_H^*, \theta_L).$$

Note, however, that the optimal level of p_H can be higher than the Pareto optimal point, meaning that the lower bound of values that p_H can take satisfies the following inequality (the left-hand side of Equation (6) from the proposition):

$$h(p_H^*, \theta_L) \geq V(K; \theta_H) - V(K; \theta_L).$$

Examining Figure 1, note that the level of p_H cannot go up indefinitely. We see that the following must also hold:

$$w_H - h(p_H^*, \theta_H) \geq w_L - h(0, \theta_H),$$

which reduces to

$$w_H - h(p_H^*, \theta_H) \geq w_L,$$

which we can rewrite as

$$h(p_H^*, \theta_H) \leq w_H - w_L = V(K; \theta_H) - V(K; \theta_L).$$

Finally, note that under these conditions of asymmetric information, the best outcome that could occur would happen at the least costly signal, where $h(p_H^*, \theta_L) = V(K; \theta_H) - V(K; \theta_L)$, i.e. at the level where the low-state manager would just not want to send a positive signal to the investor. □

Equation (6) denotes the range that p_H can take in order to sustain a separating equilibrium. If it went outside this range, a pooling equilibrium would exist instead of a separating equilibrium.

Multiplicity of Equilibria and Refinements

Note that we can have many equilibria with this model, in large part due to the beliefs that the investor has off the equilibrium path. Reasonable restrictions have been studied in order to reduce the number of equilibria coming from this type of model.

For example, recall the separating equilibrium above. To sustain some $p' \in (\tilde{p}, \hat{p})$, it must be the case that the investor, upon seeing some $p \in (\tilde{p}, p')$, would assign some positive probability to $\theta = \theta_L$. However, this is not a 'reasonable' off-equilibrium path belief since any $p \in (\tilde{p}, p')$ would make the manager in state θ_L strictly worse off to signal, no matter the beliefs of the investor. This means that any belief by the investor upon seeing a signal $p \in (\tilde{p}, p')$ other than $\mu(p) = 1$ should not occur. If so, no manager in the high state would choose any signal other than $\tilde{p}$, since any $p > \tilde{p}$ makes him strictly worse off. This refinement then produces a unique outcome for the separating equilibrium.

The next section explores the implications of the model.

COMPARATIVE STATICS AND IMPLICATIONS OF THE MODEL

Now that we have determined that equilibria exist, we can move on to some comparative statics. This section relaxes the assumption of a singleton investor. Consider now, instead of having the manager selecting a board composition free of other constraints, he now chooses the board composition keeping in mind the investors' concentration, where the investors' concentration imposes some cost on the manager.[10] Denote the level of concentration of the investors as c.

The cost function of the manager then takes the following form:

$$h(p_i, c; \theta_j),$$

where we have the same properties of the cost function as before, along with the following properties:

$$\frac{\partial h(\cdot)}{\partial c}; \frac{\partial^2 h(\cdot)}{\partial c^2}; \frac{\partial^2 h(\cdot)}{\partial p \partial c} > 0$$

and

$$\frac{\partial h(\cdot; \theta_L)}{\partial c} > \frac{\partial h(\cdot; \theta_H)}{\partial c}.$$

The problem for the manager now includes the concentration of investors and the cost that investors' concentration imposes upon him. The

higher the ability of the investors to interfere, the worse off the manager. The rest of the game remains as before. This gives rise to the next proposition.

Proposition 2:
As the level of concentration of the investors increases, the manager needs to select a lower level of p (i.e. does not need to put as many outsiders on the board of directors) to signal the correct state of the world to the investors. As the level of concentration of the investors decreases, the manager needs to select a higher level of p to signal the true state of the world to the investors.

First I will give a bit of intuition and then provide the proof. The manager has a certain level of resources at his disposal. He can use these resources to signal convincingly to the investors what the true state of the world is. The signal that differentiates the high state of the world from the low state of the world depends upon how much the manager in the low state of the world can spend on the signal. When the concentration of the investors increases, however, this imposes additional costs on the manager, leaving the manager in the low state with even fewer resources to spend on the signal. This, in turn, allows the manager in the high state of the world to spend less on the signal (in other words send a less intense signal in equilibrium) in order to differentiate himself from the manager in the low state of the world. A similar but opposite argument holds as the investors' concentration decreases. In such a situation, the level of resources at the manager's disposal increases and the signal's intensity needs to increase in order to differentiate the different states of the world. Below lies the formal proof.

Proof:
Let us start with Lemma 2—the first result concerning the appropriate level of p that the manager needs to select in order to signal the true state of the world to the investors. Recall from Equation (6) that the second best level of p_H is such that

$$h(p_H^*, c; \theta_L) = V(K; \theta_H) - V(K; \theta_L).$$

We want to know how the optimal level of p_H^* would change when the concentration of investors change (c). From the Cho–Kreps (1987) intuitive criterion, we reduced the number of equilibria to a unique outcome. Suppose we had included c in the notation previously, nothing would have changed, we would just have had extra notation. Since the equilibrium would be unique, we would have a unique value of p for every value of c. In other words, we would have $p^*(c)$.

We can then take the derivative of the above equation with respect to c. This gives us the following:

$$\frac{\partial h(p_H, c; \theta_L)}{\partial c} + \frac{\partial h(p_H, c; \theta_L)}{\partial p(c)} \frac{\partial p(c)}{\partial c} = 0,$$

which we can rewrite as

$$\frac{\partial p(c)}{\partial c} = -\frac{\partial h(p_H, c; \theta_L)/\partial c}{\partial h(p_H, c; \theta_L)/\partial p(c)}.$$

Now we know that each argument of the right-hand side, by assumption, must have a positive sign. Therefore, we have

$$\frac{\partial p(c)}{\partial c} < 0. \qquad \square$$

This gives us a testable implication: namely that as investors' concentration increases (decreases) the board composition will change so that the percentage of outsiders will decrease (increase) due to the cost imposed upon the manager. This means that the signal sent will not need to be as strong when there exists higher levels of investors' concentration.

Another testable implication that comes from this model deals with the composition of the boards of directors and the state of the world. Since this model supposes that the manager in the high state of the world has a lower cost for hiring outsiders, the model suggests that managers in the high states of the world are more likely to have outsiders on the board than managers in the low states of the world. In other words, as the firm does better, it seems more likely that the managers will allow more outsiders on the board than when the firm does worse.

CONCLUSIONS

This paper examines a signaling game between the manager and investors of a firm. The investor does not have the ability to contract easily with the manager and as a result, relies heavily upon the manager to make sound business decisions. At the same time, the manager has an informational advantage over the investor concerning the

state of the world—which the investor cannot verify until the end of the game.

However, since the investor has valuable capital, necessary for the functioning of the firm, the manager must attract the capital by signaling truthfully (and convincingly) the state of the world to the investor. The model contained in this paper shows how the manager can accomplish these objectives and what he must give up in order to do so effectively. The signal consists of the selection of the board of directors. In this paper, the board's composition has no effect on the value of the firm (i.e. the firm's productivity is in no way affected by different board structures, making the composition a pure signal). However, future research could include the board's ability to monitor as well.

The higher the percentage of outsiders found on the board of directors, the more likely the state of the world is θ_H, the high state, and the higher the cost the manager must endure to signal the true state. Some predictable implications arise from this analysis—namely that as the investors get more concentrated, the lower the signal will have to be. Also, the better the state of the world, the more likely the firm will have a higher percentage of outsiders on the board. We take these testable implications to data in O'Donoghue (2001).

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NOTES

1. Note that I have only two players, meaning only one 'investor.' However, we can think of the 'investor' as a representative investor that would make the same decisions as the investors would collectively. The use of a single investor facilitates the exposition of the model. The penultimate section relaxes this constraint.
2. See Ross (1973), Grossman and Hart (1983), and Mas-Colell *et al.* (1995) for a discussion of the standard principal/agent problem while Mookherjee (1984) extends Grossman and Hart (1983) to a setting with multiple agents and Bernheim and Whinston (1986) extends the principal/agent problem to a setting with multiple principals.
3. See Tirole (1986), Laffont and Tirole (1986), Kofman and Lamarree (1993), Beetsma *et al.* (2000), and Kessler (2000).
4. According to Olson (1971), the less dispersed a group's members, the better it can act effectively. Here the management can act while the owners, a widely dispersed set of individuals, faces serious challenges to act collectively.
5. From here on out I will use the term 'investor' to refer to the individual supplying capital to the firm. I believe this individual to be very similar to the owner of the firm—since the owner's main function is to supply the capital (and hence creating the separation of ownership and control that has come to characterize the larger hierarchical firm). However, the term 'investor' might more closely capture the role of the player.
6. In the higher state of the world, the firm is going to generate more revenues for equal or lower costs than in the lower state of the world. Since the outsiders need to be paid a salary, and many times stock options as well, along with other costs (e.g. travel expenses, etc.), the overall cost is going to be relatively greater for the lower state of the world than for the higher state of the world.
7. Standard arguments eliminating the pooling equilibrium can be made so I do not pursue this line of reasoning in this paper.
8. Note that the investors only see one wage. The manager's contract, recall, consists of a wage and a signal (w, p), both of which the investor observes. The investor cannot determine from the wage which state of the world has occurred, but must rely upon the manager to signal this in the contract through the composition of the board of directors.
9. We could introduce another term to the function $V(\cdot)$—a random term that could include further uncertainty—for example uncertainty in the marketplace—that no one can see until the end of the game when payoffs are realized. This would lead to a more realistic setting where the firm could take a loss and the investor, having decided to participate, could lose money. However, since it does not add anything to the analysis at hand, it is left out for simplicity.
10. For example, as the investors become more concentrated, they might be able to interfere with the ongoings of the firm easier. One way to think about this 'interference' is that the investors can more easily try to expropriate rents from the manager, meaning the manager needs to expend resources to prevent such opportunism.

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